

MICROGRAVITY FLUID PHYSICS RESEARCH IN THE SPACE STATION FREEDOM ERA

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ABSTRACT

Microgravity fluid physics covers an exciting range of established and potential fields of scientific research. Areas in which the Microgravity Science and Applications Division of NASA's Office of Space Science and Applications is currently supporting research include: multiphase flow and phase change heat transfer, behavior of granular media and colloids; and interface dynamics, morphological stability, and contact line phenomena. As they contribute to our knowledge of fluid behavior, advances in these areas will enhance our understanding of materials processing on Earth and in space, and will contribute to technologies as diverse as chemical extraction, the prediction of soil behavior in earthquakes, and the production of oil reservoirs.

NASA's primary platform for research in microgravity fluid physics will soon be the Fluid Physics/Dynamics Facility on Space Station Freedom. This facility shares a rack for control and utilities with the Modular Combustion Facility, and has one rack for experiment-unique instruments. It is planned to change out the content of the experiment-unique rack at intervals on the order of one year. In order to obtain a maximum return on the operation of the facility during these intervals, the research community must carefully plan and coordinate an effort that brings the efforts of many investigators to bear on problems of particular importance. NASA is currently working with the community to identify research areas in which microgravity can make a unique and valuable contribution, and to build a balanced program of research around these areas or thrusts. Selections will soon be made from our first solicitation for research in fluid dynamics and transport phenomena. Additional solicitations will be released in the future. These solicitations will build the research community that will make Space Station Freedom a catalyst for scientific and technological discovery, and offer U.S. scientists in many disciplines a unique opportunity to participate in space science.

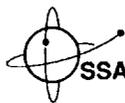


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Focus Areas for Microgravity Fluid Physics Research:

- Multiphase Flow and Heat Transfer
- Interface Dynamics
- Complex Fluids

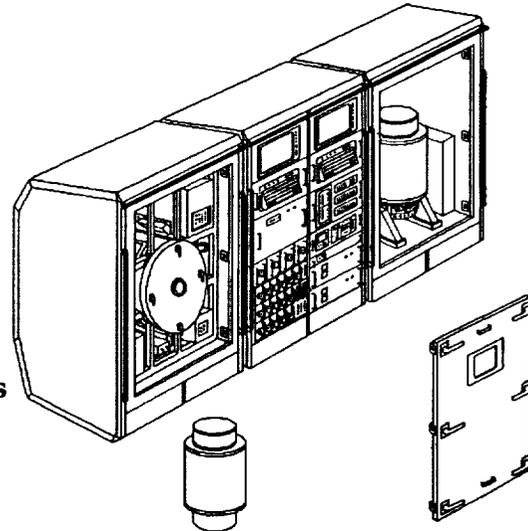
Applications of Fluid Physics Research:

- Materials Processing
- Fluids Engineering and Space Fluids Management
- Geotechnical and Environmental Engineering



Space Station Research: The Fluid Physics/Dynamics Facility

- Currently planned as part of a three-rack complex with the Modular Combustion Facility
- Core rack shared with the Modular Combustion Facility provides utilities, control, and data management support
- One rack hosts experiment-specific instrumentation
- Maximizing utilization of instrument capabilities within operational increments requires focussed and coordinated research activities



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Development of Fluid Physics Research, 1991-2000

- Space research opportunities are framed by instrument development and operational constraints
- In order to maximize the value of our space resources, we must build a coherent program from ground-based activities to instrument capabilities
- Development of working group and workshop recommendations for research priorities begin the process of structuring the research program
- A research solicitation released in 1991 identified six potential thrust areas for research in fluid dynamics and transport phenomena. 207 proposals were submitted in response. The 40-50 selected proposals will form the first generation of an evolving program
- 1991 Thrust Areas:
 - Capillary Phenomena
 - Multiphase Flow and Heat Transfer
 - Diffusive Transport
 - Magneto/Electrohydrodynamics
 - Colloids and Nucleation Phenomena
 - Solid-Fluid Interface Dynamics

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Opportunities for Microgravity Fluid Physics Research

- **Research solicitations for ground-based research and flight experiments in fluid physics (NASA Research Announcements, NRA's) planned for calendar 1993, 1996, 1999**
- **NRA's for limited ground-based support open to the entire microgravity program will be released annually beginning in early 1993**
- **Flight experiment concepts are normally developed through extensive ground-based research, often using aircraft, drop tubes, or other short-duration facilities**
- **Building a comprehensive program of ground-based research to provide candidates for flight and to support planned and potential flight experiments has high priority**

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